

# RESERVE COPY PATENT SPECIFICATION



Application Date: Jan. 16, 1931. No. 1477/31.

360,272

Complete Accepted: Nov. 5, 1931.

## COMPLETE SPECIFICATION.

### Plant for the Purification of Sewage or Waste Water.

I, FRIEDRICH SCHIMRIGK, of German Nationality, of Lassenstr. 20, Weimar, Germany, do hereby declare the nature of this invention and in what manner the same is to be performed, to be particularly described and ascertained in and by the following statement:—

In the process for the biological purification of sewage or waste water known as the activated sludge process, purification is effected by living organisms or bacteria. As oxygen must be furnished to such organisms, either compressed air is supplied or the liquid is aerated by agitation.

There are already known activated sludge processes of purification in which compressed air is supplied to the sewage or the like in a tank and at the same time the contents of the tank are mechanically agitated.

In practice, there are introduced into the tank bodies on which the organisms can settle. Such bodies usually consist of irregular aggregates of coke and the like, or consist of wooden laths or the like assembled to form a rigid structure.

The use of such bodies offers the advantage that plants operated in this way are much less sensitive to toxins and to the effects of temporary overload and temporary insufficiency of aeration than plants devoid thereof. This advantage is, however, countered by certain disadvantages.

Irregular aggregates of coke, slag and the like permit of economical use of the air diffused, but early clogging of these bodies can only be avoided if the plant is only weakly charged with sewage or waste water, so that with a given output the plant is relatively large and expensive.

If the purifying plant is heavily loaded, the bodies on which the organisms settle must be periodically cleaned. This represents an addition to the cost of operation and also renders necessary the provision of reserve plants, so that the entire installation will not require to be put out of operation to permit of the cleaning of the said bodies.

As distinguished from a loose immovable aggregate of coke, slag and the like, settlement bodies composed of wooden

laths and the like offer the advantage that they do not become clogged so rapidly. On the other hand, they suffer from the drawback that the air can readily escape from the liquid so that the consumption of air is disproportionately high.

In order now to obtain the full advantage of the known arrangements without the drawbacks, according to the invention there is used a multitude of loose migratory bodies on which the organisms can settle, the said bodies being caused to migrate each in its own path by air or water currents or mechanical means and thereby prevented from becoming clogged.

In consequence of the circulation of the bodies which may be effected continuously or intermittently it is impossible for them to be clogged, so that the installation does not require to be put out of operation for the purpose of cleaning even when it is heavily loaded.

In consequence of the small volume of the bodies in question a considerably smaller proportion of the cubical capacity of the tank is occupied by such bodies than in known arrangements. The cost of erection and of operation is correspondingly reduced. The said bodies may be as heavy as or heavier or lighter than water so that they tend to remain in suspension or to rise to the surface or to sink to the bottom. To bring about the circulation of these bodies it is therefore necessary to cause external forces to act thereon.

In the case of bodies which are heavier than water, movement of said bodies may be effected by introducing larger quantities of air than are necessary for normal operation in upwardly directed currents near the bottom of the tank. By the impact of the air jets on the bodies the latter are impelled upwardly. The effect of the air jets is increased by reason that air bubbles adhere to the bodies and increase their buoyancy.

The distribution of the air jets depends on the conditions of operation and other circumstances so that either the entire area or only a part of the area is impacted with air. Since, as a rule, the bodies are not aerated more than is necessary for biological purification, the additional

quantities of air introduced for the purpose of effecting circulation of the bodies may be effected intermittently by means of a fan which is periodically switched  
5 into and out of action by means of an electrical time switch.

If there are used bodies which are lighter than water, the external forces must be oppositely directed, that is,  
10 depending on the specific gravity of the bodies the additional forces must act in opposition to gravity or to the natural buoyancy so that the desired circulation or movement of the bodies is brought  
15 about.

By setting up water currents the strength, distribution and direction of which are adjusted in accordance with the conditions, the effect of the air jets may  
20 be supplemented.

Finally, the circulation of the bodies by air and/or water jets may be promoted by mechanical means, or mechanical means alone may be employed to effect circulation  
25 of the bodies.

Where it is desired to cause the external forces to act in vertical direction, depending on the specific gravity of the bodies the air and/or the water jets are directed  
30 vertically upwards or downwards.

In certain cases, however, it may be desired to impart movement to the bodies in some other direction by directing the currents at an angle inclined to the vertical  
35 or perpendicularly to the vertical.

The bodies may be constituted of any suitable material having the desired specific gravity and having a large surface in proportion to the volume, for example,  
40 light coke, slag, wooden rings, pumice, pumice concrete or metal. There may be advantageously used bodies consisting of wooden rings or very thin metal sheets. Wooden rings and other bodies of large  
45 volume and low specific gravity may be loaded on one side or both sides by rings of earthenware or cement, metallic pieces and the like. By suitable loading the bodies can be caused to occupy any desired  
50 position in suspension in the water. It is advantageous to employ bodies of annular or spherical structure so that they may rotate about suitable axes and thus be washed on all sides. Bast and other  
55 fibrous materials may be used in conjunction with other materials.

One embodiment of the invention is illustrated by way of example in Figs. 1 to 3 of the accompanying drawings.

60 Fig. 1 is a section through a sewage tank charged with settlement bodies.

Fig. 2 is an elevation of one of said bodies.

Fig. 3 is a transverse section of Fig. 2.  
65 As shown in Fig. 1 there are located

in the sewage tank *b* loose settlement bodies *d* which may be of the form shown in Figs. 2 and 3 or of other form. It is assumed that the bodies are naturally  
70 heavier or are loaded by the sludge to be heavier than water, so that they tend to sink to the bottom of the tank under the influence of gravity. Extending in the direction of one axis of the tank there is  
75 located beneath the grating *c* a pipe *a* through which air is led. When now sufficient air is passed through the pipe *a*, the bodies located above the pipe are moved upwards as indicated by arrows. The space immediately above the pipe *a*  
80 is thus vacated by the bodies, so that unaerated bodies can slip into the space vacated, come under the influence of the air currents and be elevated.

The ascending bodies displace laterally those located adjacent to the surface, the displaced bodies being de-aerated and caused to sink, as they are now heavier than water, so that they descend to the bottom at the sides of the tank to be  
85 again circulated.

Instead of one pipe *a* there may be employed several pipes distributed over the area of the bottom of the tank.

Besides, or in lieu of, the air supply  
95 pipe or pipes there may be employed a pipe or pipes for the supply of water under pressure. When it is intended to effect or promote the movement of the bodies by means of water jets, the arrangement and  
100 operation of such water supply pipes will be the same as the air supply pipes.

In the case where several air supply pipes are distributed over the cross-sectional area of the tank bottom the air supply may be distributed over the entire  
105 cross-sectional area or air may be introduced into certain parts only of the tank at a time.

With uniform distribution and supply  
110 of the air through several pipes or through a single pipe which is given a vibratory movement, approximately uniform upward movement is imparted to the bodies.

If the supply to certain of the pipes is  
115 cut off, there is effected non-uniform movement and consequently circulation of the bodies.

The circulating movement and/or  
120 aeration can be regulated by suitable control of the air or water jets.

If desired, buoyant bodies may be acted on by jets from manually controlled sprinklers.

By means of a suitable wire grating or  
125 the like the ascending bodies can be prevented from being washed out of the tank during the cleaning operation.

The tank may be partitioned by means  
130 of vertical gratings to form a plurality of

compartments in series so that the bodies in the compartment where the liquid enters can be prevented from becoming mixed with those at the middle and at the exit end. In this way it may be ensured in simple manner that organisms acting at the front end of the tank are stimulated more than those at the rear end. Step by step treatment of the sewage or waste water is thus rendered readily possible; this mode of treatment may be further developed by causing the liquid to traverse the several compartments in a different order.

As the air is utilised in an economical manner, the consumption of air is considerably reduced. Also fine adjustment of the air supply can be effected by use of a fan or an auxiliary fan or blower which can be switched on and off intermittently at predetermined times.

The invention is to be distinguished from a previous proposal to provide settling tanks for sewage with aerated colloid collecting surfaces such as fascines or coarse wood-wool in a wire or wicker

work net placed between partitions in the settling space of the tank, and to supply air under pressure through a pipe and at the same time to cause the liquid flowing through the tank to rise past the said surfaces, a corresponding downward flow being caused in the free spaces at the sides

Having now particularly described and ascertained the nature of my said invention and in what manner the same is to be performed, I declare that what I claim is:—

A plant for the biological purification of sewage or waste water employing a multitude of loose migratory bodies on which the organisms can settle, said bodies being caused to migrate each in its own path by air or water currents or mechanical means and thereby prevented from becoming clogged.

Dated this 15th day of January, 1931.  
CRUIKSHANK & FAIRWEATHER,  
29, St. Vincent Place, Glasgow, and  
65/66, Chancery Lane, London, W.C. 2,  
Agents for the Applicant.

[This Drawing is a reproduction of the Original on a reduced scale.]

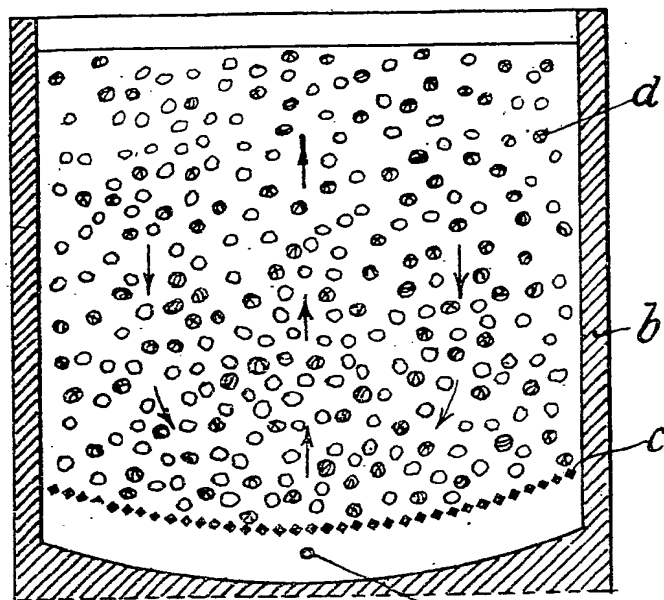


Fig. 1.

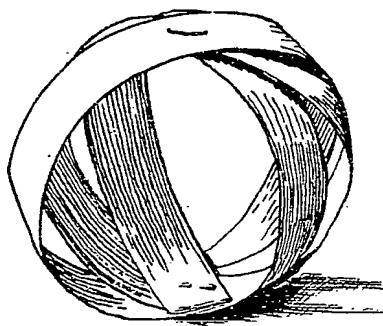


Fig. 2.

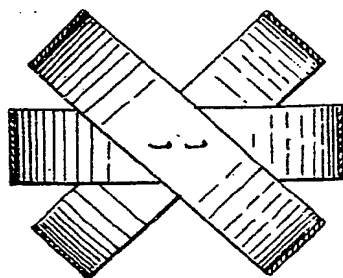


Fig. 3.

Charles & Read Ltd. Photo Litho.